



# STATE OF NEVADA

Department of Conservation & Natural Resources

DIVISION OF ENVIRONMENTAL PROTECTION

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July 8, 2008

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Re. **BMI Plant Sites and Common Areas Projects, Henderson, Nevada**  
*Generic Comparison Levels – Updated Guidance and Justification*

Dear Sirs and Madam:

All of the companies listed above shall be referred to as “the Companies” for the purposes of this letter. The NDEP issued guidance on April 21, 2008 requesting that the Companies use the USEPA Region VI Medium Specific Screening Levels (MSSLs) in conjunction with the USEPA Soil Screening Levels (SSLs). Shortly thereafter the USEPA and the Oak Ridge National Laboratory (ORNL) issued a new set of comparison levels which are intended to supersede the comparison levels previously supported by USEPA Regions III, VI and IX. NDEP does not concur with the use of the ORNL comparison levels. Some of the differences between the ORNL comparison levels and the MSSLs are described in Attachment A. Attachment A also provides justification for the NDEP’s request to continue to use the MSSLs. NDEP requests that the Companies continue to use the MSSLs and SSLs as comparison levels. NDEP will provide updates to these comparison levels as needed but no less frequently than annually. In addition, the NDEP notes that this will provide an opportunity to consider site-specific chemicals and data to adjust these comparison levels (for example toxicological surrogates derived for organic acids).

Please contact me with any questions (tel: 702-486-2850 x247; e-mail: [brakvica@ndep.nv.gov](mailto:brakvica@ndep.nv.gov)).

Sincerely,

Brian A Rakvica, P.E.  
Supervisor, Special Projects Branch  
Bureau of Corrective Actions

BAR:s

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## **Attachment A**

It is understood that Regions III, VI, and IX will depend upon the Oak Ridge National Laboratories (ORNL) Preliminary Remediation Goals (PRGs) (<http://rais.ornl.gov/>). Therefore, NDEP has conducted an in-depth review of the differences between these PRGs and U.S. EPA Region VI Media Specific Screening Levels (MSSLs) ([http://www.epa.gov/earth1r6/6pd/rcra\\_c/pd-n/screen.htm](http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm)). NDEP has concluded that there are several specific issues as discussed below which we believe render the use of the ORNL PRGs unsuitable for regulatory use at this time.

### **Exposure Parameters**

The exposure parameters are responsible for most of the observed differences between the ORNL PRGs and Region VI MSSL screening values. Primary among these, the multi-pathway ORNL PRGs do not include age-adjusted exposure parameters or account for both child and adult exposures for the residential scenarios even though child-specific exposure parameters are provided on the website. Rather, the PRG recommended for use in a residential screening level evaluation is based upon adult exposures only. In addition, the PRGs for volatile chemicals in which the inhalation pathway is included, rely upon non-standard parameters including a fraction of time spent indoors versus outdoors.

### **Toxicity Criteria**

In those instances when no verified inhalation slope factor is available from the U.S. EPA, ORNL relies upon the chemical-specific unit risk factors (URFs). While scientifically correct, in practice, this may not always be accurate given that the URFs may have been calculated based upon different exposure parameters than those to which ORNL may be applying them (e.g., breathing rates, body weights, etc.). At a minimum, this results in noticeable differences between PRG and MSSL values, and at worst, ORNL may have incorrectly utilized URFs when deriving the chemical specific PRGs.

Another critical difference in the derivation of the PRGs is that they only account for inhalation exposures when a reference concentration (RfC) or URF was available from U.S. EPA. If only a reference dose (RfD) or oral slope factor (SF) existed, then no route extrapolation was conducted with this toxicity criteria for the inhalation pathway. For example, acetone is one such chemical that often has its RfD used in lieu of an verified RfC but ORNL does not address the inhalation pathway for this constituent resulting in a dramatically higher PRG than MSSL; the latter of which accounts for the inhalation pathway via the RfD.

### **Illustrated Examples**

An examination of the PRGs for DDT, benzene, and acetone illustrate both the individual and cumulative impacts to the resulting PRGs versus a standard U.S. EPA methodology and parameters such as those used by Region VI for their MSSLs. Table 1 presents a side by side comparison of the resulting residential soil screening values for DDT from ORNL and Region VI. The screening values presented in the ORNL website for DDT is 4.3 mg/kg while the latest MSSL table provides a screening value of 1.7 mg/kg. Inclusion of the ORNL child-specific exposure parameters (which are the same as the U.S. EPA default values) into the PRG calculation results in a PRG of 1.7 mg/kg; equal to the MSSL. Tables A-1 and A-2 below provide a more detailed, analysis of the specific exposure parameters that were used in this example.

For the volatile, carcinogenic chemical benzene, there are several additional parameters that affect the PRG. Table 2 presents a side by side comparison of the resulting PRG for benzene as compared to the MSSL. Using only default parameters and methodologies from the ORNL website, the resulting PRG is 3.3 mg/kg as compared to the MSSL of 0.66 mg/kg from Region VI. The first notable exposure factor affecting the PRG is the volatilization factor (VF). ORNL utilizes non-standard factors to derive the VF in the PRG calculation rather than the default VF

from the U.S. EPA Soil Screening Level Guidance (U.S. EPA, 1996<sup>1</sup>, 2002<sup>2</sup>). Using the U.S. EPA default VF parameter, the resulting PRG would be 2.33 mg/kg. Adding in the age adjusted parameters for child exposures actually increases the PRG to 9.79 mg/kg due to the soil ingestion playing a more dominant role in the calculated PRG at this point in the comparison.

As noted previously, the PRGs use a URF rather than inhalation SFs; such is the case for benzene. However, when the inhalation SF is used in lieu of the URF in conjunction with an age-adjusted inhalation factor, the PRG for benzene is reduced to 1.7 mg/kg (Table 2).

Finally, ORNL PRGs include an indoor dilution factor and a time spent indoors versus outdoors factor. By removing these values from the calculation, the PRG for benzene equals the MSSL at 0.66 mg/kg. Tables A-3 through A-7 provide a detailed analysis of the specific exposure parameters that were used in this example. Acetone is one final example that demonstrates the resulting differences in the ORNL approach in deriving PRGs. As presented, ORNL provides a PRG of 627,000 mg/kg for acetone in residential soils as opposed to 14,000 mg/kg for the MSSL (Table 3). Addition of the child specific exposure parameters drops the PRG by an order of magnitude to 68,000 mg/kg. Adding in the inhalation pathway through the use of the oral RfD converted to an inhalation RfC, further reduces the PRG to 29,000 mg/kg. Finally, by removing the parameters for time spent indoors from the equation, the PRG for acetone equals the MSSL at 14,000 mg/kg. Tables A-8 through A-11 provide a detailed analysis of the specific exposure parameters that were used in this example.

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<sup>1</sup> U.S. EPA. 1996. Soil Screening Guidance: User's Guide. Publication 9355.4-23. United States Environmental Protection Agency. Office of Solid Waste & Emergency Response.

<sup>2</sup> U.S. EPA. 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER Publication 9355.4-24. United States Environmental Protection Agency. Office of Solid Waste & Emergency Response.

**Table 1. SUMMARY OF ORNL PRGs VERSUS USEPA REGION VI MSSLS.**

**DDT in Residential Soil**

<b>Scenario</b>	<b>ORNL PRG (mg/kg)</b>	<b>USEPA Region VI MSSL (mg/kg)</b>
As reported	4.3	1.7
ORNL PRG with age adjustment for soil ingestion and dermal contact pathways	1.7	1.7

**TABLE 2. SUMMARY OF ORNL PRGs VERSUS USEPA REGION VI MSSLS.**  
**Benzene in Residential Soil**

Scenario	ORNL PRG (mg/kg)	USEPA Region VI MSSL (mg/kg)
As reported	3.3	0.66
ORNL PRG using same VF as MSSLS	2.3	0.66
ORNL PRG using same VF as MSSLS and with age adjustment for soil ingestion and dermal contact pathways	9.8	0.66
ORNL PRG using same VF as MSSLS, with age adjustment for soil ingestion and dermal contact pathways, and using inhalation slope factor with age adjustment for inhalation pathway	1.7	0.66
ORNL PRG using same VF as MSSLS, with age adjustment for soil ingestion and dermal contact pathways, using inhalation slope factor with age adjustment for inhalation pathway, and without indoor dilution factor	0.66	0.66

**TABLE 3. SUMMARY OF ORNL PRGs VERSUS USEPA REGION VI MSSLS.**  
**Acetone in Residential Soil**

Scenario	ORNL PRG (mg/kg)	USEPA Region VI MSSL (mg/kg)
As reported	627,000	14,000
ORNL PRG with child parameters for soil ingestion and dermal contact pathways	68,000	14,000
ORNL PRG with child parameters for soil ingestion and dermal contact pathways, and using an inhalation RfC derived from the oral RfD	29,000	14,000
ORNL PRG with child parameters for soil ingestion and dermal contact pathways, using an inhalation RfC derived from the oral RfD, and without indoor dilution factor	14,000	14,000

# APPENDIX

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**TABLE A-1. COMPARISON OF MULTIPATHWAY ORNL PRG WITH USEPA REGION VI MSSL**  
**Residential Soil Screening Level for DDT**

Exposure Parameter	ORNL PRG	ORNL PRG	USEPA	USEPA	Units	Explanation
	Symbol	Value	Region VI	Region VI		
GENERAL PARAMETERS						
Target Risk	T	1.00E-06	TR	1.00E-06	unitless	
Averaging Time	AT	25,550	AT	25,550	days	
Exposure Frequency	EF	350	EF	350	days/year	
Exposure Duration - residential	ED	30	ED <sub>r</sub>	30	years	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Exposure Duration - child		NA	ED <sub>c</sub>	6	years	
Body Weight - adult	BW	70	BW <sub>a</sub>	70	kg	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Body Weight - child		NA	BW <sub>c</sub>	15	kg	
SOIL INGESTION PATHWAY						
Soil Ingestion Rate - adult	IR	100	IRS <sub>a</sub>	100	mg/day	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Soil Ingestion Rate - child		NA	IRS <sub>c</sub>	200	mg/day	
Age-adjusted Soil Ingestion Factor		NA	IFS <sub>adj</sub>	114	(mg*yr)/(kg*d)	IFSadj = (ED <sub>c</sub> *IRS <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IRS <sub>a</sub> /BW <sub>a</sub> )
INHALATION PATHWAY						
Inhalation rate - adult		NA	IRA <sub>a</sub>	20	m <sup>3</sup> /day	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age.
Inhalation rate - child		NA	IRA <sub>c</sub>	10	m <sup>3</sup> /day	
Age-adjusted Inhalation Factor		NA	InhFadj	11	(m <sup>3</sup> *yr)/(kg*d)	InhFadj = (ED <sub>c</sub> *IRA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IRA <sub>a</sub> /BW <sub>a</sub> )
Particulate emission factor	PEF	1.32E+09	PEF	1.32E+09	m <sup>3</sup> /kg	
Exposure Time outdoors	ET <sub>ro</sub>	0.073		NA	hour/hour	ORNL adjusts the PEF to account for dilution of outdoor particulate sources in the indoor environment and increased exposure time indoors.
Exposure Time indoors	ET <sub>ri</sub>	0.683		NA	hour/hour	
Indoor Dilution Factor	DF <sub>i</sub>	0.4		NA	unitless	
DERMAL CONTACT PATHWAY						
Adherence Factor - adult	AF	0.07	AF <sub>a</sub>	0.07	mg/cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Adherence Factor - child		NA	AF <sub>c</sub>	0.2	mg/cm <sup>2</sup>	
Exposed Skin Surface area - adult	SA	5700	SA <sub>a</sub>	5700	cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Exposed Skin Surface area - child			SA <sub>c</sub>	2800	cm <sup>2</sup>	
Age-adjusted Skin Contact Factor			SFS <sub>adj</sub>	361	(mg*yr)/(kg*d)	SFSadj = (ED <sub>c</sub> *AF <sub>c</sub> *SA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *AF <sub>a</sub> *SA <sub>a</sub> /BW <sub>a</sub> )
Skin Absorption Factor	ABS	0.03	ABS	0.03	unitless	
TOXICITY CRITERIA						
Oral cancer slope factor	TV <sub>o</sub>	0.34	SF <sub>o</sub>	0.34	1/(mg/kg-day)	
Absorbed cancer slope factor	TV <sub>ad</sub>	0.486	SF <sub>o</sub>	0.34	1/(mg/kg-day)	ORNL derives dermal slope factor based on absorption while Region 6 uses oral slope factor.
Inhalation cancer slope factor		NA	SF <sub>i</sub>	0.34	1/(mg/kg-day)	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age. In absence of URF, inhalation pathway is not included.
Unit Risk Factor	TV <sub>i</sub>	0.097		NA	1/(mg/m <sup>3</sup> )	
Screening Level	PRG	4.28	MSSL	1.7	mg/kg	

**TABLE A-2. COMPARISON OF MULTIPATHWAY ORNL PRG WITH USEPA REGION VI MSSL**  
**Residential Soil Screening Level for DDT**                      **ORNL PRG with Age-Adjustment**

Exposure Parameter	ORNL PRG	ORNL PRG	USEPA	USEPA	Units	Explanation
	Symbol	Value	Region VI	Region VI		
GENERAL PARAMETERS						
Target Risk	T	1.00E-06	TR	1.00E-06	unitless	
Averaging Time	AT	25,550	AT	25,550	days	
Exposure Frequency	EF	350	EF	350	days/year	
Exposure Duration - residential	ED	30	ED <sub>r</sub>	30	years	ORNL PRGs are calculated using adult exposure parameters
Exposure Duration - child		6	ED <sub>c</sub>	6	years	only without age-adjustment.
Body Weight - adult	BW	70	BW <sub>a</sub>	70	kg	ORNL PRGs are calculated using adult exposure parameters
Body Weight - child		15	BW <sub>c</sub>	15	kg	only without age-adjustment.
SOIL INGESTION PATHWAY						
Soil Ingestion Rate - adult	IR	100	IRS <sub>a</sub>	100	mg/day	ORNL PRGs are calculated using adult exposure parameters
Soil Ingestion Rate - child		200	IRS <sub>c</sub>	200	mg/day	only without age-adjustment.
Age-adjusted Soil Ingestion Factor		114	IFS <sub>adj</sub>	114	(mg*yr)/(kg*d)	IFSadj = (ED <sub>c</sub> *IRS <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IRS <sub>a</sub> /BW <sub>a</sub> )
INHALATION PATHWAY						
Inhalation rate - adult		NA	IRA <sub>a</sub>	20	m <sup>3</sup> /day	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age.
Inhalation rate - child		NA	IRA <sub>c</sub>	10	m <sup>3</sup> /day	
Age-adjusted Inhalation Factor		NA	InhFadj	11	(m <sup>3</sup> *yr)/(kg*d)	InhFadj = (ED <sub>c</sub> *IRA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IRA <sub>a</sub> /BW <sub>a</sub> )
Particulate emission factor	PEF	1.32E+09	PEF	1.32E+09	m <sup>3</sup> /kg	ORNL adjusts the PEF to account for dilution of outdoor particulate sources in the indoor environment and increased exposure time indoors.
Exposure Time outdoors	ET <sub>ro</sub>	0.073		NA	hour/hour	
Exposure Time indoors	ET <sub>ri</sub>	0.683		NA	hour/hour	
Indoor Dilution Factor	DF <sub>i</sub>	0.4		NA	unitless	
DERMAL CONTACT PATHWAY						
Adherence Factor - adult	AF	0.07	AF <sub>a</sub>	0.07	mg/cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters
Adherence Factor - child		0.2	AF <sub>c</sub>	0.2	mg/cm <sup>2</sup>	only without age-adjustment.
Exposed Skin Surface area - adult	SA	5700	SA <sub>a</sub>	5700	cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters
Exposed Skin Surface area - child		2800	SA <sub>c</sub>	2800	cm <sup>2</sup>	only without age-adjustment.
Age-adjusted Skin Contact Factor		361	SFS <sub>adj</sub>	361	(mg*yr)/(kg*d)	SFSadj = (ED <sub>c</sub> *AF <sub>c</sub> *SA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *AF <sub>a</sub> *SA <sub>a</sub> /BW <sub>a</sub> )
Skin Absorption Factor	ABS	0.03	ABS	0.03	unitless	
TOXICITY CRITERIA						
Oral cancer slope factor	TV <sub>o</sub>	0.34	SF <sub>o</sub>	0.34	1/(mg/kg-day)	ORNL derives dermal slope factor based on absorption while Region 6 uses oral slope factor.
Absorbed cancer slope factor	TV <sub>ad</sub>	0.486	SF <sub>o</sub>	0.34	1/(mg/kg-day)	
Inhalation cancer slope factor		NA	SF <sub>i</sub>	0.34	1/(mg/kg-day)	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age. In absence of URF, inhalation pathway is not included.
Unit Risk Factor	TV <sub>i</sub>	0.097		NA	1/(mg/m <sup>3</sup> )	
Screening Level	PRG	1.65	MSSL	1.7	mg/kg	

**TABLE A-3. COMPARISON OF MULTIPATHWAY ORNL PRG WITH USEPA REGION VI MSSL**  
**Residential Soil Screening Level for Benzene**

Exposure Parameter	ORNL PRG	ORNL PRG	USEPA	USEPA	Units	Explanation
	Symbol	Value	Region VI Symbol	Region VI Value		
GENERAL PARAMETERS						
Target Risk	T	1.00E-06	TR	1.00E-06	unitless	
Averaging Time	AT	25,550	AT	25,550	days	
Exposure Frequency	EF	350	EF	350	days/year	
Exposure Duration - residential	ED	30	ED <sub>r</sub>	30	years	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Exposure Duration - child		NA	ED <sub>c</sub>	6	years	
Body Weight - adult	BW	70	BW <sub>a</sub>	70	kg	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Body Weight - child		NA	BW <sub>c</sub>	15	kg	
SOIL INGESTION PATHWAY						
Soil Ingestion Rate - adult	IR	100	IRS <sub>a</sub>	100	mg/day	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Soil Ingestion Rate - child		NA	IRS <sub>c</sub>	200	mg/day	
Age-adjusted Soil Ingestion Factor		NA	IFS <sub>adj</sub>	114	(mg*yr)/(kg*d)	IFSadj = (ED <sub>c</sub> *IRS <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IRS <sub>a</sub> /BW <sub>a</sub> )
INHALATION PATHWAY						
Inhalation rate - adult		NA	IRA <sub>a</sub>	20	m <sup>3</sup> /day	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age.
Inhalation rate - child		NA	IRA <sub>c</sub>	10	m <sup>3</sup> /day	
Age-adjusted Inhalation Factor		NA	InhFadj	11	(m <sup>3</sup> *yr)/(kg*d)	InhFadj = (ED <sub>c</sub> *IRA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IRA <sub>a</sub> /BW <sub>a</sub> )
Volatilization Factor	VF	4.06E+03	VF	2.80E+03	m <sup>3</sup> /kg	ORNL uses Q/C based on Los Angeles, CA while Region 6 uses default Q/C from 1996 SSL guidance, otherwise VFs are the same. ORNL adjusts the VF to account for dilution of outdoor particulate sources in the indoor environment and increased exposure time indoors.
Exposure Time outdoors	ET <sub>ro</sub>	0.073		NA	hour/hour	
Exposure Time indoors	ET <sub>ri</sub>	0.683		NA	hour/hour	
Indoor Dilution Factor	DF <sub>i</sub>	0.4		NA	unitless	
DERMAL CONTACT PATHWAY						
Adherence Factor - adult	AF	0.07	AF <sub>a</sub>	0.07	mg/cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Adherence Factor - child		NA	AF <sub>c</sub>	0.2	mg/cm <sup>2</sup>	
Exposed Skin Surface area - adult	SA	5700	SA <sub>a</sub>	5700	cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Exposed Skin Surface area - child			SA <sub>c</sub>	2800	cm <sup>2</sup>	
Age-adjusted Skin Contact Factor			SFS <sub>adj</sub>	361	(mg*yr)/(kg*d)	SFSadj = (ED <sub>c</sub> *AF <sub>c</sub> *SA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *AF <sub>a</sub> *SA <sub>a</sub> /BW <sub>a</sub> )
Skin Absorption Factor	ABS	0.01	ABS		unitless	Region 6 does not include dermal if there is no absorption factor for the chemical.
TOXICITY CRITERIA						
Oral cancer slope factor	TV <sub>o</sub>	0.055	SF <sub>o</sub>	0.055	1/(mg/kg-day)	ORNL derives dermal slope factor based on absorption while Region 6 uses oral slope factor.
Absorbed cancer slope factor	TV <sub>ad</sub>	0.0567	SF <sub>o</sub>	0.055	1/(mg/kg-day)	
Inhalation cancer slope factor		NA	SF <sub>i</sub>	0.027	1/(mg/kg-day)	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age. In absence of URF, inhalation pathway is not included.
Unit Risk Factor	TV <sub>i</sub>	0.0078		NA	1/(mg/m <sup>3</sup> )	
Screening Level	PRG	3.26	MSSL	0.66	mg/kg	

**TABLE A-4. COMPARISON OF MULTIPATHWAY ORNL PRG WITH USEPA REGION VI MSSL**  
**Residential Soil Screening Level for Benzene**      **Region VI VF used for ORNL calculations**

Exposure Parameter	ORNL PRG	ORNL PRG	USEPA	USEPA	Units	Explanation
	Symbol	Value	Region VI Symbol	Region VI Value		
GENERAL PARAMETERS						
Target Risk	T	1.00E-06	TR	1.00E-06	unitless	
Averaging Time	AT	25,550	AT	25,550	days	
Exposure Frequency	EF	350	EF	350	days/year	
Exposure Duration - residential	ED	30	ED <sub>r</sub>	30	years	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Exposure Duration - child		NA	ED <sub>c</sub>	6	years	
Body Weight - adult	BW	70	BW <sub>a</sub>	70	kg	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Body Weight - child		NA	BW <sub>c</sub>	15	kg	
SOIL INGESTION PATHWAY						
Soil Ingestion Rate - adult	IR	100	IR <sub>a</sub>	100	mg/day	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Soil Ingestion Rate - child		NA	IR <sub>c</sub>	200	mg/day	
Age-adjusted Soil Ingestion Factor		NA	IFS <sub>adj</sub>	114	(mg*yr)/(kg*d)	IFSadj = (ED <sub>c</sub> *IR <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IR <sub>a</sub> /BW <sub>a</sub> )
INHALATION PATHWAY						
Inhalation rate - adult		NA	IRA <sub>a</sub>	20	m <sup>3</sup> /day	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age.
Inhalation rate - child		NA	IRA <sub>c</sub>	10	m <sup>3</sup> /day	
Age-adjusted Inhalation Factor		NA	InhFadj	11	(m <sup>3</sup> *yr)/(kg*d)	InhFadj = (ED <sub>c</sub> *IRA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IRA <sub>a</sub> /BW <sub>a</sub> )
Volatilization Factor	VF	2.80E+03	VF	2.80E+03	m <sup>3</sup> /kg	ORNL uses Q/C based on Los Angeles, CA while Region 6 uses default Q/C from 1996 SSL guidance, otherwise VFs are the same. ORNL adjusts the VF to account for dilution of outdoor particulate sources in the indoor environment and increased exposure time indoors.
Exposure Time outdoors	ET <sub>ro</sub>	0.073		NA	hour/hour	
Exposure Time indoors	ET <sub>ri</sub>	0.683		NA	hour/hour	
Indoor Dilution Factor	DF <sub>i</sub>	0.4		NA	unitless	
DERMAL CONTACT PATHWAY						
Adherence Factor - adult	AF	0.07	AF <sub>a</sub>	0.07	mg/cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Adherence Factor - child		NA	AF <sub>c</sub>	0.2	mg/cm <sup>2</sup>	
Exposed Skin Surface area - adult	SA	5700	SA <sub>a</sub>	5700	cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Exposed Skin Surface area - child			SA <sub>c</sub>	2800	cm <sup>2</sup>	
Age-adjusted Skin Contact Factor			SFS <sub>adj</sub>	361	(mg*yr)/(kg*d)	SFSadj = (ED <sub>c</sub> *AF <sub>c</sub> *SA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *AF <sub>a</sub> *SA <sub>a</sub> /BW <sub>a</sub> )
Skin Absorption Factor	ABS	0.01	ABS		unitless	Region 6 does not include dermal if there is no absorption factor for the chemical.
TOXICITY CRITERIA						
Oral cancer slope factor	TV <sub>o</sub>	0.055	SF <sub>o</sub>	0.055	1/(mg/kg-day)	ORNL derives dermal slope factor based on absorption while Region 6 uses oral slope factor.
Absorbed cancer slope factor	TV <sub>ad</sub>	0.0567	SF <sub>o</sub>	0.055	1/(mg/kg-day)	
Inhalation cancer slope factor		NA	SF <sub>i</sub>	0.027	1/(mg/kg-day)	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age. In absence of URF, inhalation pathway is not included.
Unit Risk Factor	TV <sub>i</sub>	0.0078		NA	1/(mg/m <sup>3</sup> )	
Screening Level	PRG	2.33	MSSL	0.66	mg/kg	

**TABLE A-5. COMPARISON OF MULTIPATHWAY ORNL PRG WITH USEPA REGION VI MSSL**  
**Residential Soil Screening Level for Benzene**

ORNL PRG with Region VI VF and Age-Adjustment

Exposure Parameter	ORNL PRG Symbol	ORNL PRG Value	USEPA	USEPA	Units	Explanation
			Region VI Symbol	Region VI Value		
GENERAL PARAMETERS						
Target Risk	T	1.00E-06	TR	1.00E-06	unitless	
Averaging Time	AT	25,550	AT	25,550	days	
Exposure Frequency	EF	350	EF	350	days/year	
Exposure Duration - residential	ED	30	ED <sub>r</sub>	30	years	ORNL PRGs are calculated using adult exposure parameters
Exposure Duration - child		6	ED <sub>c</sub>	6	years	only without age-adjustment.
Body Weight - adult	BW	70	BW <sub>a</sub>	70	kg	ORNL PRGs are calculated using adult exposure parameters
Body Weight - child		15	BW <sub>c</sub>	15	kg	only without age-adjustment.
SOIL INGESTION PATHWAY						
Soil Ingestion Rate - adult	IR	100	IR <sub>a</sub>	100	mg/day	ORNL PRGs are calculated using adult exposure parameters
Soil Ingestion Rate - child		200	IR <sub>c</sub>	200	mg/day	only without age-adjustment.
Age-adjusted Soil Ingestion Factor		114	IFS <sub>adj</sub>	114	(mg*yr)/(kg*d)	IFS <sub>adj</sub> = (ED <sub>c</sub> *IR <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IR <sub>a</sub> /BW <sub>a</sub> )
INHALATION PATHWAY						
Inhalation rate - adult		NA	IRA <sub>a</sub>	20	m <sup>3</sup> /day	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age.
Inhalation rate - child		NA	IRA <sub>c</sub>	10	m <sup>3</sup> /day	
Age-adjusted Inhalation Factor		NA	InhF <sub>adj</sub>	11	(m <sup>3</sup> *yr)/(kg*d)	InhF <sub>adj</sub> = (ED <sub>c</sub> *IRA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IRA <sub>a</sub> /BW <sub>a</sub> )
Particulate emission factor	VF	2.80E+03	VF	2.80E+03	m <sup>3</sup> /kg	
Exposure Time outdoors	ET <sub>ro</sub>	0.073		NA	hour/hour	ORNL adjusts the PEF to account for dilution of outdoor particulate sources in the indoor environment and increased exposure time indoors.
Exposure Time indoors	ET <sub>ri</sub>	0.683		NA	hour/hour	
Indoor Dilution Factor	DF <sub>i</sub>	0.4		NA	unitless	
DERMAL CONTACT PATHWAY						
Adherence Factor - adult	AF	0.07	AF <sub>a</sub>	0.07	mg/cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters
Adherence Factor - child		0.2	AF <sub>c</sub>	0.2	mg/cm <sup>2</sup>	only without age-adjustment.
Exposed Skin Surface area - adult	SA	5700	SA <sub>a</sub>	5700	cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters
Exposed Skin Surface area - child		2800	SA <sub>c</sub>	2800	cm <sup>2</sup>	only without age-adjustment.
Age-adjusted Skin Contact Factor		361	SFS <sub>adj</sub>	361	(mg*yr)/(kg*d)	SFS <sub>adj</sub> = (ED <sub>c</sub> *AF <sub>c</sub> *SA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *AF <sub>a</sub> *SA <sub>a</sub> /BW <sub>a</sub> )
Skin Absorption Factor	ABS	0.01	ABS		unitless	
TOXICITY CRITERIA						
Oral cancer slope factor	TV <sub>o</sub>	0.055	SF <sub>o</sub>	0.055	1/(mg/kg-day)	ORNL derives dermal slope factor based on absorption while Region 6 uses oral slope factor.
Absorbed cancer slope factor	TV <sub>ad</sub>	0.0567	SF <sub>o</sub>	0.055	1/(mg/kg-day)	
Inhalation cancer slope factor		NA	SF <sub>i</sub>	0.027	1/(mg/kg-day)	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age. In absence of URF, inhalation pathway is not included.
Unit Risk Factor	TV <sub>i</sub>	0.0078		NA	1/(mg/m <sup>3</sup> )	
Screening Level	PRG	9.79	MSSL	0.66	mg/kg	

TABLE A-6. COMPARISON OF MULTIPATHWAY ORNL PRG WITH USEPA REGION VI MSSL

Residential Soil Screening Level for Benzene

ORNL PRG with Region VI VF, Age-Adjustment, and inhalation SF

Exposure Parameter	ORNL PRG	ORNL PRG	USEPA	USEPA	Units	Explanation
	Symbol	Value	Region VI Symbol	Region VI Value		
GENERAL PARAMETERS						
Target Risk	T	1.00E-06	TR	1.00E-06	unitless	
Averaging Time	AT	25,550	AT	25,550	days	
Exposure Frequency	EF	350	EF	350	days/year	
Exposure Duration - residential	ED	30	ED <sub>r</sub>	30	years	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Exposure Duration - child		6	ED <sub>c</sub>	6	years	
Body Weight - adult	BW	70	BW <sub>a</sub>	70	kg	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Body Weight - child		15	BW <sub>c</sub>	15	kg	
SOIL INGESTION PATHWAY						
Soil Ingestion Rate - adult	IR	100	IR <sub>a</sub>	100	mg/day	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Soil Ingestion Rate - child		200	IR <sub>c</sub>	200	mg/day	
Age-adjusted Soil Ingestion Factor		114	IFS <sub>adj</sub>	114	(mg*yr)/(kg*d)	IFSadj = (ED <sub>c</sub> *IR <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IR <sub>a</sub> /BW <sub>a</sub> )
INHALATION PATHWAY						
Inhalation rate - adult		20	IRA <sub>a</sub>	20	m <sup>3</sup> /day	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age.
Inhalation rate - child		10	IRA <sub>c</sub>	10	m <sup>3</sup> /day	
Age-adjusted Inhalation Factor		11	InhFadj	11	(m <sup>3</sup> *yr)/(kg*d)	InhFadj = (ED <sub>c</sub> *IRA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IRA <sub>a</sub> /BW <sub>a</sub> )
Particulate emission factor	VF	2.80E+03	VF	2.80E+03	m <sup>3</sup> /kg	
Exposure Time outdoors	ET <sub>ro</sub>	0.073		NA	hour/hour	ORNL adjusts the PEF to account for dilution of outdoor particulate sources in the indoor environment and increased exposure time indoors.
Exposure Time indoors	ET <sub>ri</sub>	0.683		NA	hour/hour	
Indoor Dilution Factor	DF <sub>i</sub>	0.4		NA	unitless	
DERMAL CONTACT PATHWAY						
Adherence Factor - adult	AF	0.07	AF <sub>a</sub>	0.07	mg/cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Adherence Factor - child		0.2	AF <sub>c</sub>	0.2	mg/cm <sup>2</sup>	
Exposed Skin Surface area - adult	SA	5700	SA <sub>a</sub>	5700	cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters only without age-adjustment.
Exposed Skin Surface area - child		2800	SA <sub>c</sub>	2800	cm <sup>2</sup>	
Age-adjusted Skin Contact Factor		361	SFS <sub>adj</sub>	361	(mg*yr)/(kg*d)	SFSadj = (ED <sub>c</sub> *AF <sub>c</sub> *SA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *AF <sub>a</sub> *SA <sub>a</sub> /BW <sub>a</sub> )
Skin Absorption Factor	ABS	0.01	ABS		unitless	
TOXICITY CRITERIA						
Oral cancer slope factor	TV <sub>o</sub>	0.055	SF <sub>o</sub>	0.055	1/(mg/kg-day)	ORNL derives dermal slope factor based on absorption while Region 6 uses oral slope factor.
Absorbed cancer slope factor	TV <sub>ad</sub>	0.0567	SF <sub>o</sub>	0.055	1/(mg/kg-day)	
Inhalation cancer slope factor		0.027	SF <sub>i</sub>	0.027	1/(mg/kg-day)	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age. In absence of URF, inhalation pathway is not included.
Unit Risk Factor	TV <sub>i</sub>	0.0078		NA	1/(mg/m <sup>3</sup> )	
Soil ingestion XF		6.286E-06		8.61E-02		
Dermal XF		2.046E-07		0.00E+00		
Inhalation XF		3.625E-05		1.43E+00		
Screening Level	PRG	1.71	MSSL	0.66	mg/kg	

**TABLE A-7. COMPARISON OF MULTIPATHWAY ORNL PRG WITH USEPA REGION VI MSSL**  
**Residential Soil Screening Level for Benzene**

ORNL PRG with Region VI VF, Age-Adjustment, inhalation SF, and no indoor dilution factor

Exposure Parameter	ORNL PRG Symbol	ORNL PRG Value	USEPA	USEPA	Units	Explanation
			Region VI Symbol	Region VI Value		
GENERAL PARAMETERS						
Target Risk	T	1.00E-06	TR	1.00E-06	unitless	
Averaging Time	AT	25,550	AT	25,550	days	
Exposure Frequency	EF	350	EF	350	days/year	
Exposure Duration - residential	ED	30	ED <sub>r</sub>	30	years	ORNL PRGs are calculated using adult exposure parameters
Exposure Duration - child		6	ED <sub>c</sub>	6	years	only without age-adjustment.
Body Weight - adult	BW	70	BW <sub>a</sub>	70	kg	ORNL PRGs are calculated using adult exposure parameters
Body Weight - child		15	BW <sub>c</sub>	15	kg	only without age-adjustment.
SOIL INGESTION PATHWAY						
Soil Ingestion Rate - adult	IR	100	IR <sub>a</sub>	100	mg/day	ORNL PRGs are calculated using adult exposure parameters
Soil Ingestion Rate - child		200	IR <sub>c</sub>	200	mg/day	only without age-adjustment.
Age-adjusted Soil Ingestion Factor		114	IFS <sub>adj</sub>	114	(mg*yr)/(kg*d)	IFS <sub>adj</sub> = (ED <sub>c</sub> *IR <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IR <sub>a</sub> /BW <sub>a</sub> )
INHALATION PATHWAY						
Inhalation rate - adult		20	IRA <sub>a</sub>	20	m <sup>3</sup> /day	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age.
Inhalation rate - child		10	IRA <sub>c</sub>	10	m <sup>3</sup> /day	
Age-adjusted Inhalation Factor		11	InhF <sub>adj</sub>	11	(m <sup>3</sup> *yr)/(kg*d)	InhF <sub>adj</sub> = (ED <sub>c</sub> *IRA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *IRA <sub>a</sub> /BW <sub>a</sub> )
Particulate emission factor	VF	2.80E+03	VF	2.80E+03	m <sup>3</sup> /kg	
Exposure Time outdoors	ET <sub>ro</sub>	1		NA	hour/hour	ORNL adjusts the PEF to account for dilution of outdoor
Exposure Time indoors	ET <sub>ri</sub>	0		NA	hour/hour	particulate sources in the indoor environment and
Indoor Dilution Factor	DF <sub>i</sub>	1		NA	unitless	increased exposure time indoors.
DERMAL CONTACT PATHWAY						
Adherence Factor - adult	AF	0.07	AF <sub>a</sub>	0.07	mg/cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters
Adherence Factor - child		0.2	AF <sub>c</sub>	0.2	mg/cm <sup>2</sup>	only without age-adjustment.
Exposed Skin Surface area - adult	SA	5700	SA <sub>a</sub>	5700	cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters
Exposed Skin Surface area - child		2800	SA <sub>c</sub>	2800	cm <sup>2</sup>	only without age-adjustment.
Age-adjusted Skin Contact Factor		361	SFS <sub>adj</sub>	361	(mg*yr)/(kg*d)	SFS <sub>adj</sub> = (ED <sub>c</sub> *AF <sub>c</sub> *SA <sub>c</sub> /BW <sub>c</sub> ) + (ED <sub>a</sub> *AF <sub>a</sub> *SA <sub>a</sub> /BW <sub>a</sub> )
Skin Absorption Factor	ABS	0.01	ABS		unitless	
TOXICITY CRITERIA						
Oral cancer slope factor	TV <sub>o</sub>	0.055	SF <sub>o</sub>	0.055	1/(mg/kg-day)	
Absorbed cancer slope factor	TV <sub>ad</sub>	0.0567	SF <sub>o</sub>	0.055	1/(mg/kg-day)	ORNL derives dermal slope factor based on absorption while Region 6 uses oral slope factor.
Inhalation cancer slope factor		0.027	SF <sub>i</sub>	0.027	1/(mg/kg-day)	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age. In absence of URF, inhalation pathway
Unit Risk Factor	TV <sub>i</sub>	0.0078		NA	1/(mg/m <sup>3</sup> )	is not included.
Soil ingestion XF		6.286E-06		8.61E-02		
Dermal XF		2.046E-07		0.00E+00		
Inhalation XF		0.0001047		1.43E+00		
Screening Level	PRG	0.66	MSSL	0.66	mg/kg	

**TABLE A-8. COMPARISON OF MULTIPATHWAY ORNL PRG WITH USEPA REGION VI MSSL**  
**Residential Soil Screening Level for Acetone**

Exposure Parameter	ORNL PRG Symbol	ORNL PRG Value	USEPA Region VI Symbol	USEPA Region VI Value	Units	Explanation
GENERAL PARAMETERS						
Target Hazard Quotient	T	1.00E+00	THQ	1.00E+00	unitless	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Averaging Time	AT	10,950	AT	2,190	days	
Exposure Frequency	EF	350	EF	350	days/year	
Exposure Duration - residential	ED	30	ED <sub>r</sub>	6	years	
Body Weight - adult	BW	70	BW <sub>a</sub>	NA	kg	
Body Weight - child		NA	BW <sub>c</sub>	15	kg	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
SOIL INGESTION PATHWAY						
Soil Ingestion Rate - adult	IR	100	IRS <sub>a</sub>	NA	mg/day	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Soil Ingestion Rate - child		NA	IRS <sub>c</sub>	200	mg/day	
INHALATION PATHWAY						
Inhalation rate - adult		NA	IRA <sub>a</sub>	NA	m <sup>3</sup> /day	Inhalation pathway for ORNL PRGs and Region 6 MSSLs are based on RfC when it exists. MSSLs are based on inhalation RfD when RfC does not exist.
Inhalation rate - child		NA	IRA <sub>c</sub>	10	m <sup>3</sup> /day	
Volatilization Factor	VF	1.27E+04	VF	1.26E+04	m <sup>3</sup> /kg	ORNL uses Q/C based on Los Angeles, CA while Region 6 uses default Q/C from 1996 SSL guidance, otherwise VFs are the same. ORNL adjusts the VF to account for dilution of outdoor particulate sources in the indoor environment and increased exposure time indoors.
Exposure Time outdoors	ET <sub>ro</sub>	0.073		NA	hour/hour	
Exposure Time indoors	ET <sub>ri</sub>	0.683		NA	hour/hour	
Indoor Dilution Factor	DF <sub>i</sub>	0.4		NA	unitless	
DERMAL CONTACT PATHWAY						
Adherence Factor - adult	AF	0.07	AF <sub>a</sub>	NA	mg/cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Adherence Factor - child		NA	AF <sub>c</sub>	0.2	mg/cm <sup>2</sup>	
Exposed Skin Surface area - adult	SA	5700	SA <sub>a</sub>	NA	cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Exposed Skin Surface area - child			SA <sub>c</sub>	2800	cm <sup>2</sup>	
Skin Absorption Factor	ABS	0.01	ABS		unitless	Region 6 does not include dermal if there is no absorption factor for the chemical.
TOXICITY CRITERIA						
Oral Reference Dose	TV <sub>o</sub>	0.9	RfD <sub>o</sub>	0.9	mg/kg-day	ORNL derives dermal slope factor based on absorption while Region 6 uses oral slope factor.
Absorbed Reference Dose	TV <sub>ad</sub>	0.747	RfD <sub>o</sub>	0.9	mg/kg-day	
Inhalation Reference Dose		NA	RfD <sub>i</sub>	0.9	mg/kg-day	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age. In absence of URF, inhalation pathway is not included.
Reference Concentration	TV <sub>i</sub>			NA	mg/m <sup>3</sup>	
Soil ingestion XF		0.0001111		1.42E-05		
Dermal XF		5.341E-06		0.00E+00		
Inhalation XF				5.64E-05		
Screening Level	PRG	626,865	MSSL	14,169	mg/kg	



**TABLE A-9. COMPARISON OF MULTIPATHWAY ORNL PRG WITH USEPA REGION VI MSSL**  
**Residential Soil Screening Level for Acetone**                      **ORNL PRG with Age-Adjustment**

Exposure Parameter	ORNL PRG Symbol	ORNL PRG Value	USEPA Region VI Symbol	USEPA Region VI Value	Units	Explanation
<b>GENERAL PARAMETERS</b>						
Target Hazard Quotient	T	1.00E+00	THQ	1.00E+00	unitless	
Averaging Time	AT	2,190	AT	2,190	days	
Exposure Frequency	EF	350	EF	350	days/year	
Exposure Duration - residential	ED	6	ED <sub>r</sub>	6	years	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Body Weight - adult	BW	15	BW <sub>a</sub>	NA	kg	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Body Weight - child		NA	BW <sub>c</sub>	15	kg	
<b>SOIL INGESTION PATHWAY</b>						
Soil Ingestion Rate - adult	IR	200	IR <sub>Sa</sub>	NA	mg/day	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Soil Ingestion Rate - child		NA	IR <sub>Sc</sub>	200	mg/day	
<b>INHALATION PATHWAY</b>						
Inhalation rate - adult		NA	IRA <sub>a</sub>	NA	m <sup>3</sup> /day	Inhalation pathway for ORNL PRGs and Region 6 MSSLs are based on RfC when it exists. MSSLs are based on inhalation RfD when RfC does not exist.
Inhalation rate - child		10	IRA <sub>c</sub>	10	m <sup>3</sup> /day	ORNL uses Q/C based on Los Angeles, CA while Region 6 uses default Q/C from 1996 SSL guidance, otherwise VFs are the same.
Volatilization Factor	VF	1.27E+04	VF	1.26E+04	m <sup>3</sup> /kg	ORNL adjusts the VF to account for dilution of outdoor particulate sources in the indoor environment and increased exposure time indoors.
Exposure Time outdoors	ET <sub>ro</sub>	0.073		NA	hour/hour	
Exposure Time indoors	ET <sub>ri</sub>	0.683		NA	hour/hour	
Indoor Dilution Factor	DF <sub>i</sub>	0.4		NA	unitless	
<b>DERMAL CONTACT PATHWAY</b>						
Adherence Factor - adult	AF	0.2	AF <sub>a</sub>	NA	mg/cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Adherence Factor - child		NA	AF <sub>c</sub>	0.2	mg/cm <sup>2</sup>	
Exposed Skin Surface area - adult	SA	2800	SA <sub>a</sub>	NA	cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Exposed Skin Surface area - child			SA <sub>c</sub>	2800	cm <sup>2</sup>	Region 6 does not include dermal if there is no absorption factor for the chemical.
Skin Absorption Factor	ABS	0.01	ABS		unitless	
<b>TOXICITY CRITERIA</b>						
Oral Reference Dose	TV <sub>o</sub>	0.9	RfD <sub>o</sub>	0.9	mg/kg-day	ORNL derives dermal slope factor based on absorption while Region 6 uses oral slope factor.
Absorbed Reference Dose	TV <sub>ad</sub>	0.747	RfD <sub>o</sub>	0.9	mg/kg-day	
Inhalation Reference Dose		NA	RfD <sub>i</sub>	0.9	mg/kg-day	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age. In absence of URF, inhalation pathway is not included.
Reference Concentration	TV <sub>i</sub>			NA	mg/m <sup>3</sup>	
Soil ingestion XF		0.0002222		1.42E-05		
Dermal XF		7.497E-06		0.00E+00		
Inhalation XF				5.64E-05		
<b>Screening Level</b>	<b>PRG</b>	<b>68,096</b>	<b>MSSL</b>	<b>14,169</b>	<b>mg/kg</b>	

**TABLE A-10. COMPARISON OF MULTIPATHWAY ORNL PRG WITH USEPA REGION VI MSSL**  
**Residential Soil Screening Level for Acetone**                      **ORNL PRG with Age-Adjustment and RfC derived from oral RfD**

Exposure Parameter	ORNL PRG Symbol	ORNL PRG Value	USEPA	USEPA	Units	Explanation
			Region VI Symbol	Region VI Value		
GENERAL PARAMETERS						
Target Hazard Quotient	T	1.00E+00	THQ	1.00E+00	unitless	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Averaging Time	AT	2,190	AT	2,190	days	
Exposure Frequency	EF	350	EF	350	days/year	
Exposure Duration - residential	ED	6	ED <sub>r</sub>	6	years	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Body Weight - adult	BW	15	BW <sub>a</sub>	NA	kg	
Body Weight - child		NA	BW <sub>c</sub>	15	kg	
SOIL INGESTION PATHWAY						
Soil Ingestion Rate - adult	IR	200	IRS <sub>a</sub>	NA	mg/day	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Soil Ingestion Rate - child		NA	IRS <sub>c</sub>	200	mg/day	
INHALATION PATHWAY						
Inhalation rate - adult		NA	IRA <sub>a</sub>	NA	m <sup>3</sup> /day	Inhalation pathway for ORNL PRGs and Region 6 MSSLs are based on RfC when it exists. MSSLs are based on inhalation RfD when RfC does not exist.
Inhalation rate - child		10	IRA <sub>c</sub>	10	m <sup>3</sup> /day	
Volatilization Factor	VF	1.27E+04	VF	1.26E+04	m <sup>3</sup> /kg	ORNL uses Q/C based on Los Angeles, CA while Region 6 uses default Q/C from 1996 SSL guidance, otherwise VFs are the same.  ORNL adjusts the VF to account for dilution of outdoor particulate sources in the indoor environment and increased exposure time indoors.
Exposure Time outdoors	ET <sub>ro</sub>	0.073		NA	hour/hour	
Exposure Time indoors	ET <sub>ri</sub>	0.683		NA	hour/hour	
Indoor Dilution Factor	DF <sub>i</sub>	0.4		NA	unitless	
DERMAL CONTACT PATHWAY						
Adherence Factor - adult	AF	0.2	AF <sub>a</sub>	NA	mg/cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Adherence Factor - child		NA	AF <sub>c</sub>	0.2	mg/cm <sup>2</sup>	
Exposed Skin Surface area - adult	SA	2800	SA <sub>a</sub>	NA	cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Exposed Skin Surface area - child			SA <sub>c</sub>	2800	cm <sup>2</sup>	
Skin Absorption Factor	ABS	0.01	ABS		unitless	Region 6 does not include dermal if there is no absorption factor for the chemical.
TOXICITY CRITERIA						
Oral Reference Dose	TV <sub>o</sub>	0.9	RfD <sub>o</sub>	0.9	mg/kg-day	ORNL derives dermal slope factor based on absorption while Region 6 uses oral slope factor.
Absorbed Reference Dose	TV <sub>ad</sub>	0.747	RfD <sub>o</sub>	0.9	mg/kg-day	
Inhalation Reference Dose		NA	RfD <sub>i</sub>	0.9	mg/kg-day	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age. In absence of URF, inhalation pathway is not included.
Reference Concentration	TV <sub>i</sub>	1.35		NA	mg/m <sup>3</sup>	
Screening Level	PRG	29,370	MSSL	14,169	mg/kg	

**TABLE A-11. COMPARISON OF MULTIPATHWAY ORNL PRG WITH USEPA REGION VI MSSL**  
**Residential Soil Screening Level for Acetone**                      **ORNL PRG with Age-Adjustment, RfC, and no indoor dilution**

Exposure Parameter	ORNL PRG Symbol	ORNL PRG Value	USEPA Region VI Symbol	USEPA Region VI Value	Units	Explanation
<b>GENERAL PARAMETERS</b>						
Target Hazard Quotient	T	1.00E+00	THQ	1.00E+00	unitless	
Averaging Time	AT	2,190	AT	2,190	days	
Exposure Frequency	EF	350	EF	350	days/year	
Exposure Duration - residential	ED	6	ED <sub>r</sub>	6	years	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Body Weight - adult	BW	15	BW <sub>a</sub>	NA	kg	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Body Weight - child		NA	BW <sub>c</sub>	15	kg	
<b>SOIL INGESTION PATHWAY</b>						
Soil Ingestion Rate - adult	IR	200	IR <sub>s</sub> <sub>a</sub>	NA	mg/day	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Soil Ingestion Rate - child		NA	IR <sub>s</sub> <sub>c</sub>	200	mg/day	
<b>INHALATION PATHWAY</b>						
Inhalation rate - adult		NA	IRA <sub>a</sub>	NA	m <sup>3</sup> /day	Inhalation pathway for ORNL PRGs and Region 6 MSSLs are based on RfC when it exists. MSSLs are based on inhalation RfD when RfC does not exist.
Inhalation rate - child		10	IRA <sub>c</sub>	10	m <sup>3</sup> /day	ORNL uses Q/C based on Los Angeles, CA while Region 6 uses default Q/C from 1996 SSL guidance, otherwise VFs are the same.
Volatilization Factor	VF	1.27E+04	VF	1.26E+04	m <sup>3</sup> /kg	ORNL adjusts the VF to account for dilution of outdoor particulate sources in the indoor environment and increased exposure time indoors.
Exposure Time outdoors	ET <sub>ro</sub>	1		NA	hour/hour	
Exposure Time indoors	ET <sub>ri</sub>	0		NA	hour/hour	
Indoor Dilution Factor	DF <sub>i</sub>	1		NA	unitless	
<b>DERMAL CONTACT PATHWAY</b>						
Adherence Factor - adult	AF	0.2	AF <sub>a</sub>	NA	mg/cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Adherence Factor - child		NA	AF <sub>c</sub>	0.2	mg/cm <sup>2</sup>	
Exposed Skin Surface area - adult	SA	2800	SA <sub>a</sub>	NA	cm <sup>2</sup>	ORNL PRGs are calculated using adult exposure parameters while Region 6 MSSLs are calculated using child only for noncarcinogenic chemicals.
Exposed Skin Surface area - child			SA <sub>c</sub>	2800	cm <sup>2</sup>	Region 6 does not include dermal if there is no absorption factor for the chemical.
Skin Absorption Factor	ABS	0.01	ABS		unitless	
<b>TOXICITY CRITERIA</b>						
Oral Reference Dose	TV <sub>o</sub>	0.9	RfD <sub>o</sub>	0.9	mg/kg-day	ORNL derives dermal slope factor based on absorption while Region 6 uses oral slope factor.
Absorbed Reference Dose	TV <sub>ad</sub>	0.747	RfD <sub>o</sub>	0.9	mg/kg-day	
Inhalation Reference Dose		NA	RfD <sub>i</sub>	0.9	mg/kg-day	Inhalation pathway for ORNL PRGs is based on URF with no adjustment for age. In absence of URF, inhalation pathway is not included.
Reference Concentration	TV <sub>i</sub>	1.35		NA	mg/m <sup>3</sup>	
<b>Screening Level</b>	<b>PRG</b>	<b>14,161</b>	<b>MSSL</b>	<b>14,169</b>	<b>mg/kg</b>	